

What is claimed is:

1 1. A 3-D display device comprising:

2 a display means that displays left and right images at respective left and right positions on
3 a display panel, the left and right images being partially overlapped on the display panel;

4 an optical magnifying system having left and right optical viewing systems with respective
5 optical axes that are aligned substantially parallel with one another, the left optical viewing system
6 having an exit pupil and an effective aperture that includes the optical axis of the right optical
7 viewing system, and the right optical viewing system having an exit pupil and an effective aperture
8 that includes the optical axis of the left optical viewing system;

9 wherein, of the left and right images displayed on the display panel, only the left images
10 are viewable at the left exit pupil and only the right images are viewable at the right exit pupil.

1 2. The 3-D display device according to Claim 1, wherein:

2 the left and right images have polarizations which are independent of each other;
3 the left and right optical viewing systems of the optical magnifying system have
4 polarizations which are independent of each other;

5 the polarization of the right image is the same as the polarization of the right viewing
6 system, and the polarization of the left image is the same as the polarization of the left viewing
7 system.

1 3. The 3-D display device according to Claim 1, wherein:

2 the display means displays the left and right images alternately on the display panel in a
3 time-multiplexed manner; and

4 the displaying of the left and right images is synchronized with a switching operation
5 between the left and right optical viewing systems so that the right optical viewing system forms
6 only right images and the left optical viewing system forms only left images.

1 4. The 3-D display device according to Claim 1, wherein:

2 the display means displays the left and right images using different wavelengths of light
3 which do not overlap; and

4 the optical magnifying system includes optical elements which operate on a light beam or
5 do not operate on a light beam depending on the wavelength of the light beam, such that the left
6 optical viewing system forms left images and does not form right images, and the right optical
7 viewing system forms right images and does not form left images.

1 5. The 3-D display device according to Claim 1, wherein:

2 the distance between the exit pupils is adjustable by changing the distance between the left
3 and right viewing systems, which changes the distance between the left and right displayed
4 images.

1 6. The 3-D display device according to Claim 1, wherein:

2 one of the distance between the left and right displayed images and the distance between the
3 left and right viewing systems is separately adjustable.

1 7. The 3-D display device according to Claim 1, wherein:

2 the left and right images on the display panel are displayed alternately, in a time-
3 multiplexed manner;

4 the left and right images have polarizations which are independent of each other; and

5 the left optical viewing system passes the polarization of the left image and does not pass
6 the polarization of the right image, and the right optical viewing system passes the polarization of
7 the right image and does not pass the polarization of the left image.

1 8. The 3-D display device according to Claim 1 wherein:

2 the left and right images on the display panel are displayed alternately in a time-division
3 manner;

the left and right optical systems have optical axes which are de-centered with respect to a centerline of the display panel; and

a reconfigurable holographic optical element is provided which is turned on/off in a time-division manner in synchronism with the display of left and right images.

9. The 3-D display device according to Claim 1 wherein:

the display means displays the left and right images using different wavelengths of light which do not overlap;

the left and right optical systems have optical axes which are substantially parallel and a thick holographic optical element is provided such that the left optical viewing system forms left images and does not form right images, and the right optical viewing system forms right images and does not form left images.

10. A 3-D display device comprising:

a display means that displays left and right images at respective left and right display panels, the left and right images having polarizations that are independent of one another;

an optical magnifying system having left and right optical viewing systems with respective optical axes that are aligned substantially parallel with one another, the left optical viewing system having an exit pupil and an effective aperture that includes the optical axis of the right optical viewing system, and the right optical viewing system having an exit pupil and an effective aperture that includes the optical axis of the left optical viewing system;

wherein, the left and right optical systems have respective left and right optical axes for different polarizations of light which are independent of each other such that, of the left and right images displayed on the display panels, only the left images are viewable at the left exit pupil and only the right images are viewable at the right exit pupil.

11. A 3-D display device comprising:

a display means that includes a display panel, said display means displaying left and right

images on the display panel in positions that are shifted to the left and right, respectively; and
an optical magnifying system which includes left and right optical viewing systems, the
left and right optical viewing systems having separate optical axes, the left optical viewing system
having an effective aperture that includes the optical axis of the right optical viewing system, and
the right optical viewing system having an effective aperture that includes the optical axis of the
left optical viewing system;

wherein

the left and right optical viewing systems convey light having different polarizations,
different wavelengths, or different time-division periods such that the left optical viewing system
forms only left images and the right optical viewing system forms only right images,

the left image and the left optical viewing system share a first common polarization,
wavelength, or time-division period, and

the right image and the right optical viewing system share a different polarization,
wavelength, or time-division period.

12. A viewing device for viewing 3-D images which comprises:

a display means which displays left and right images alternately on a display panel;

an optical magnifying system which provides images to left and right exit pupils of the
viewing device; and

at least two holographic optical elements having different optical axes, each holographic
optical element having an effective aperture that includes the optical axis of the other holographic
optical element.

13. A 3-D display device comprising:

a display means which includes display panels, the display means displaying, in a time-
division manner, left and right images having polarized components which are independent of one
another;

an optical magnifying system that forms intermediate images of the images displayed by

the display means;

a birefringent, diffractive optical element located at the position of the intermediate images; and

a viewing optical system having left and right optical paths and an effective aperture that exceeds the interpupillary distance of a viewer, with the viewing optical system positioned between the intermediate image and the viewer;

wherein

the left and right optical paths are switched, at the position of the intermediate images according to the polarization of the light forming the intermediate images, to respective left and right exit pupils of the viewing optical system.

14. A 3-D display device comprising:

a display means which includes display panels, the display means displaying, in a time-division manner, left and right images having polarized components which are independent of one another;

an optical magnifying system which forms intermediate images of the images displayed by the display means;

a reconfigurable holographic optical element, positioned at the location of the intermediate images, the polarization of the holographic optical element being switchable in a time-division manner so as to be synchronized with the display of left and right images; and

a viewing system, positioned between the intermediate images and a viewer, and having an effective aperture that exceeds the interpupillary distance of the viewer;

wherein

left and right images are formed at respective left and right exit pupils, said left and right images being images of the intermediate images according to the switching of the reconfigurable holographic optical element in a time-division manner.

15. A 3-D display device comprising:

2 a display means that includes display panels, said display means displaying left and right
3 images on the display panels;

4 an optical system positioned in each light path following the displayed left and right
5 images which forms collimated left and right light beams;

6 left and right apertures, respectively, positioned in the collimated left and right light
7 beams;

8 an imaging lens for focusing the collimated left and right light beams onto the same
9 position; and

10 an optical magnifying system that forms intermediate images of the displayed left and right
11 images;

12 wherein

13 the light at the intermediate images is divided into left and right light paths by a difference
14 in the positions of the entrance pupils of the light forming the intermediate images; and

15 a viewing system that forms images of the intermediate images at respective left and right
16 exit pupils, the viewing system having an effective aperture that exceeds the distance between the
17 left and right exit pupils.

1 16. The 3-D display device according to Claim 15 wherein

2 the distance between the left and right exit pupils may be changed by changing the
3 distance between said collimated left and right beams so as to adjust distance between the left and
4 right exit pupils to the interpupillary distance of a viewer.